

LATERAL CONTROLS FOR PILE FOUNDATIONS

By Ray Zelinski

The following table provides guidelines for lateral soil springs and capacities for evaluating existing pile foundations for retrofit projects.

Pile Type	Soil Type	Ultimate Lateral Capacity (K/Pile)	Maximum Allowable Displacements (Inches)	Assumed Lateral Soil Spring (K/In)
Steel Pipe	Dense Granular	100	3	35
Steel Pipe	Loose Granular	75	3	25
Steel Pipe	Soft Cohesive	60	2	30
Concrete	Dense Granular	40	1	40
Concrete	Loose Granular	40	2	20
Concrete	Soft Cohesive	40	2	20

The tabulated numerical values are based on several assumptions and tests as follows:

1. Loads and displacements rely on both pile and pile cap interaction with surrounding soils.
2. Behavior of steel piles in dense and soft soils are derived from Cypress Viaduct tests as interpreted and summarized by Yashinsky and Zelinski. Piles were 12 3/4" O.D. by 0.219" concrete filled steel pipes.
3. Behavior of concrete piles in dense soils is derived from a Caltrans test performed several years ago on a well confined reinforced 16" Ø CIDH pile. The pile developed 20 K/in capacity in dense soil without cap participation.
4. Behavior of steel and concrete piles in other soils are extrapolated from the two sets of tests identified in 2. and 3. Displacements were limited by evaluation of pile ductility details and behavior of piles in varying soils at Cypress Viaduct tests.
5. Steel H-piles can be allowed the same capacity as for the pipe piles about the strong axis. The capacity and stiffness in the weak direction should be reduced. As-built plans should not be considered reliable for determining the orientation of the H-pile axis.
6. Raymond piles can be considered equal in capacity and stiffness to the 16" Ø test pile for lateral loads providing the 1" and 2" displacements are not exceeded for dense and loose/soft soils respectively.

The tabulated pile soil springs and capacities should be sufficient to meet most site conditions. You should verify that subsurface site conditions are consistent with conditions and assumptions used for compiling the table. A review of the existing Log of Test Boring sheets by yourself and a geotechnical engineer should be sufficient to make that determination.

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The designer can set soil springs to a stiffness which will allow the footing to translate "equal" to the table values in a dynamic model. The number of piles is then determined by dividing the column plastic hinging shear force by the capacity allowed in the table.

The design resulting from this procedure will be one which allows the structure to translate a reasonable distance for expected lateral force demands without sacrificing the structural integrity of the piles. The designer, of course, needs to exercise some judgment when evaluating pile translations and capacities for foundations mixing existing and new piles.